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Screening of Methicillin Resistant *Staphylococcus Aureus (MRSA)* Carriage among Health Care Workers and Its Antibiotic Susceptibility Pattern in a Tertiary Care Hospital

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ABSTRACT

Background and Objectives: Staphylococcus aureus infections especially MRSA infections are an important cause of nosocomial infections worldwide and multidrug resistance is also very commonly seen in these infections. In a healthcare setup, these infections can be acquired through the hands, clothes, and equipments of health care workers. Hence, this study was conducted to see the percentage of MRSA carriage among healthcare workers and to study their antibiotic susceptibility pattern.
Materials and Methods: Nasal swabs collected from various categories of Healthcare workers were subjected to processing in the Bacteriology section of Microbiology lab, GMC Jammu. Staphylococcus aureus identification was done according to the standard procedures of the lab. Cefoxitin disc was used for the identification of MRSA strains.
Results: A total of 240 volunteers participated in the study. Among the samples screened 38 (16%) were MRSA, 28 (12%) were MSSA. In 172 (72%) no colonization was seen. Highest prevalence of MRSA was seen among Nurses 18 (27%), followed by Laboratory Technicians 10 (15%), Doctors 6 (9%) and Paramedics 4 (6%). Vancomycin and Linezolid were the most sensitive drugs showing 100 % sensitivity. Penicillin was 100 % resistant.
Conclusion: A study of MRSA carriage among healthcare workers can help in framing proper and timely antibiotic policies in our hospital which would further stop the emergence of multidrug resistant organism and also guide us in decreasing the prevalence of nosocomial infections.

Keywords: MRSA, Healthcare workers

INTRODUCTION

Methicillin resistant Staphylococcus aureus (MRSA) strains were initially described in the 1960s. The first semi synthetic anti staphylococcal penicillins were also developed around 1960s and *Methicillin resistant Staphylococcus aureus (MRSA)* was observed within 1 year of their first clinical use. In fact, genomic evidence suggests that methicillin resistance even preceded the first clinical use of anti staphylococcal penicillins. Methicillin resistance is mediated by mecA gene and acquired by horizontal transfer of a mobile genetic element designated staphylococcal cassette chromosome mec (SCCmec). The gene mecA encodes penicillin binding protein 2a (PBP2a), an enzyme responsible for cross-linking the peptidoglycans in the bacterial cell wall. PBP2a has a low affinity for β lactams, resulting in resistance to this entire class of antibiotics. *Methicillin resistant Staphylococcus aureus (MRSA)* is endemic in India and has emerged in the last decade as a cause of nosocomial infections responsible for rapidly progressive, potential fatal diseases including life threatening pneumonia, necrotizing fascitis, endocarditis, osteomyelitis, severe sepsis,

and toxic shock syndrome (TSS). It is a well recognized public health problem worldwide that causes severe morbidity and mortality of the patients and increase treatment cost, especially in developing country like ours [1,2]. Healthcare associated infections (HCAIs) are now very difficult to treat. Cross-transmission of infections in between patients by healthcare workers (HCWs) also plays a role [3]. HCAI has become a potential risk worldwide. *Staphylococcus spp.*, especially Methicillin resistant Staphylococcus aureus (MRSA) is one of the frequent causes of HCAIs4. Health-care workers (HCWs) play a role in colonizing and transmitting microorganism to patient causing HCAIs. Nearly any item in contact with skin can serve as a fomite in MRSA transmission, from aprons and ties to pens, stethoscopes and mobile phones. Colonization can persist for long periods of time. Staphylococcus aureus colonizes various places and mucous membrane of the human body, most commonly at anterior nares [5].The other sites where MRSA can colonise are the axilla, groin, perineum, gastrointestinal tract and less commonly rectum and vagina. The MRSA carrier stage ranges from 16.8%–90% in different countries [6,7]. MRSA carriage among HCWs can render other measures of infection control ineffective [8,9]. Generally the HCW's are mostly asymptomatic, but they can be a potential reservoir of infection for susceptible patients. Vancomycin is the drug of choice for the treatment for MRSA infections. Identification of patients and HCWs in outbreak settings colonized with MRSA combined with hand hygiene and other precautions have been shown to be effective in reducing the transmission and controlling the spread of MRSA. Even with the ongoing development of newer antibiotics, active surveillance efforts and advances in infection prevention, MRSA remains a prominent pathogen with persistently high mortality. Knowledge of the prevalence of MRSA and its antimicrobial profile is necessary for selection of the appropriate empirical antimicrobial treatment for Staphylococcus aureus infections. In particular, screening for and eradication of MRSA from colonized HCWs have been recognized and recommended as an important part of a comprehensive infection control policy for this organism.

It is with this background that the present study was undertaken to investigate the nasal carriage of MRSA among HCWs at our hospital and provide a holistic approach to the problem of infections caused due to MRSA. This study might also help the infection control committee in formulation of a MRSA policy based on the outcomes. Furthermore, we describe the antibiotic susceptibility patterns of the MRSA strains isolated.

MATERIALS AND METHODS

This prospective study was carried out in the Bacteriology section of the Department of Microbiology, Government Medical College, Jammu, India for a period of 3 months (November 2020 – January 2021). The study was conducted on health care workers who volunteered for the study and were on duty during the study period. Health care worker implied any staff member (Doctors, Nurses, Laboratory Technicians, Housekeeping Staff and any other allied health care worker) working in the management of admitted patients in the indoor and students (medical and nursing) who were on clinical rotation to the units. Health care workers who were not willing to participate in the study were excluded from the study. The total number of health care workers who were included in the study were 240. A detailed questionnaire was used to obtain demographic data like age, sex, designation, relevant history, antibiotic usage, past surgery, history of any chronic illness like hypertension, diabetes etc. The health care workers were enrolled after a written informed consent was obtained from them. Samples were collected from both anterior nares using sterile swabs with a standard rotating technique. Firstly, the swabs were moistened with sterile

physiological saline. The swab was then introduced 2-3 cm in the nasal cavity and rotated 4-5 times both clockwise and anticlockwise. The same swab was used for swabbing the other nostril by the same method. The swab was returned to the plastic tube and closed tightly. The plastic tube was labelled properly and immediately transported to the microbiology laboratory for bacteriological analysis. The samples were processed within 2 hours after their collection. The swabs were inoculated onto Mannitol salt agar (MSA) plates and incubated at 37°C for 18-24 hours. Any growth was identified as *Staphylococcus aureus* by using standard procedures to study colony morphology, microscopic appearance on gram stained smears, catalase test, tube coagulase test. Mannitol fermenting colonies that were yellow/golden yellow were selected and subcultured on Nutrient agar (NA). Colonies on Nutrient agar were subjected to Gram's staining, catalase test and tube coagulase test. Gram positive cocci that were catalase positive and tube coagulase positive were identified as Staphylococcus aureus. The isolated strains of Staphylococcus aureus were screened for methicillin susceptibility by modified Kirby Bauer method, using 30 ug Cefoxitin discs on Mueller Hinton agar (MHA) by using an inoculum density which was equivalent to McFarland's 0.5 standard (1.5x108 CFU/ml) and inoculating it at 35oC overnight. Isolates which show inhibition zone sizes of diameter ≤21 mm were considered as MRSA strains. Antibiotic susceptibility testing for all isolates of Staphylococcus aureus was done against other antibiotics. All antibiotic susceptibility tests was conducted by using Staphylococcus aureus ATCC 25923, MRSA ATCC 29213 and MSSA ATCC 33591 as controls under similar conditions as used for test strains. Antibiotic sensitivity testing and interpretation of results was done as recommended by the clinical and laboratory standards institute (CLSI) guidelines. In case of vancomycin, isolates with inhibition zone sizes of diameter ≤15 mm were considered as vancomycin resistant.

Figure 1: Colonies of *Staphylococcus aureus* on Blood agar after isolation

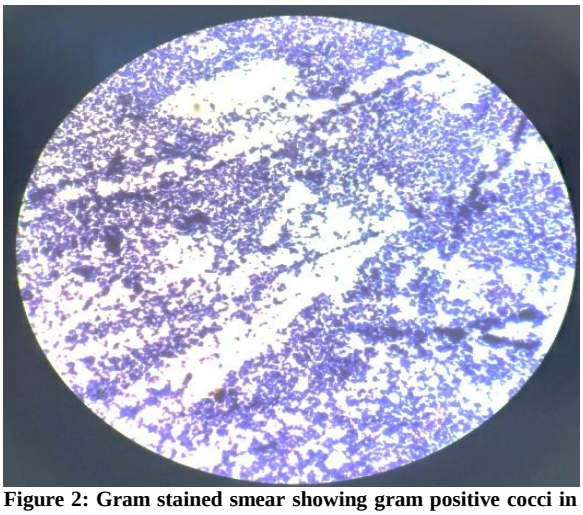

Figure 2: Gram stained smear showing gram positive cocci in clusters

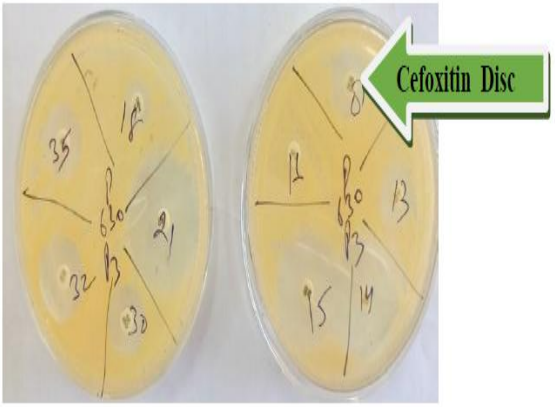

Figure 3: Mueller Hinton agar showing antibiotic sensitivity

RESULTS

Of the 240 participants included in the study, 192 (80%) were male and 48 (20 %) were female. Participants from various

working profession were included in the study - 95 (40%) nurses, 70 (29%) doctors, 50 (21%) paramedics and 25 (10.4%) were laboratory technicians (TABLE 1).

Among the samples screened 38 (16%) were MRSA and 28 (12%) were MSSA. In 172 (72%) samples, no colonization was seen. (FIGURE 4).

TABLE 1: Demographic characteristics of participants

GENDER (n = 240)	
MALE	48 (20%)
FEMALE	192 (80 %)
WORKING PROFESSION (n=240)	
DOCTORS	70 (29 %)
NURSES	95 (40 %)
PARAMEDICS	50 (21 %)
LABORATORY TECHNICIANS	25 (10.4 %)

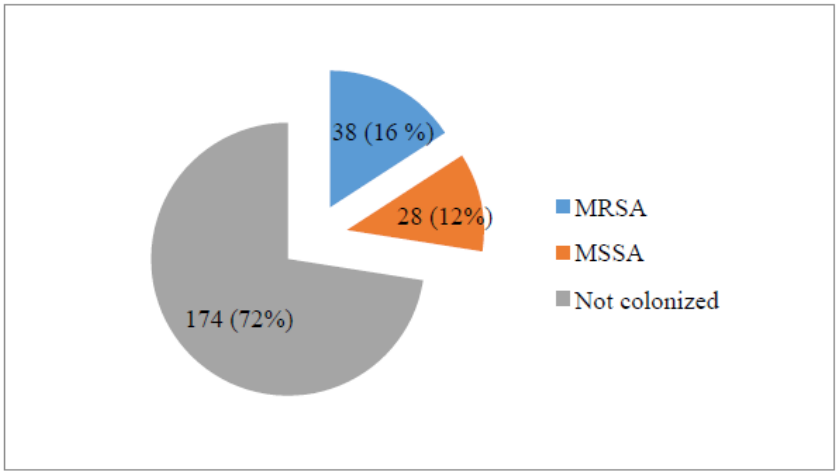

FIGURE 4 : Percentage distribution of MRSA and MSSA

Highest prevalence of MRSA was seen among Nurses 18 (27%), followed by Laboratory Technicians 10 (15%), Doctors 6 (9%) and Paramedics 4 (6%) (TABLE 2).

Regarding Antibiotic sensitivity patterns for MRSA, Vancomycin and Linezolid were 100 % (38) sensitive, Ciprofloxacin 25 (66%) sensitive, Clindamycin 18 (47%) sensitive. Cefoxitin and Pencillin were 100 % (38) resistant (TABLE 3).

Regarding Antibiotic sensitivity patterns for Methicillin Sensitive Staphylococcus aureus (MSSA), Vancomycin and Linezolid were 100% (28) sensitive, Clindamycin 20 (71%) sensitive, Ciprofloxacin 18 (64%) sensitive. Penicillin was 100% (28) resistant (TABLE 3).

TABLE 2: Prevalence of MRSA and MSSA among Health care workers

PROFESSION	MRSA (n=66)	MSSA (n=66)
Doctors	6 (9 %)	5(8 %)
Nurses	18 (27 %)	19 (29%)
Paramedics	4 (6 %)	2 (3%)
Laboratory Technicians	10 (15%)	2(3%)

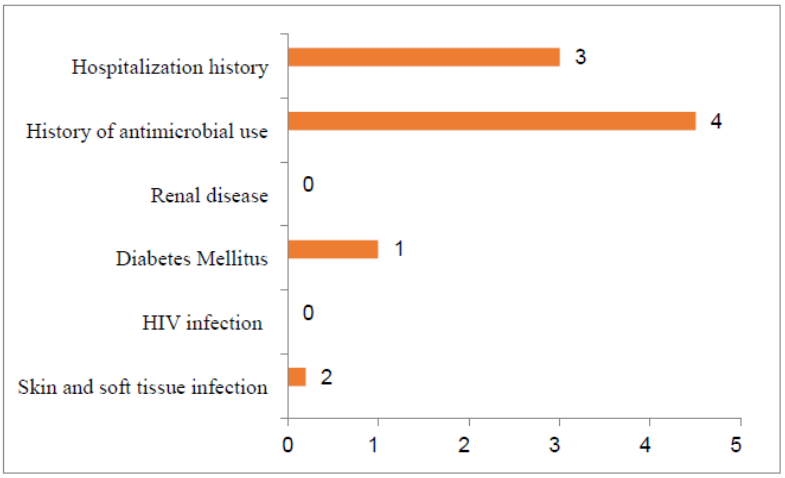

FIGURE 5: Effect of various risk factors on colonization

TABLE 3: Antibiotic sensitivity pattern of MRSA and MSSA isolates

Antimicrobial	MRSA (n=38)		MSSA (n= 28)	
	Sensitive	Resistant	Sensitive	Resistant
Penicillin	0	38 (100 %)	0	28 (100 %)
Cefoxitin	0	38 (100 %)	28 (100 %)	0
Ciprofloxacin	25 (66%)	13(3.4%)	18 (64%)	10 (36%)
Clindamycin	18(47%)	20 (53%)	20 (71%)	8(29%)
Erythromycin	20 (53%)	18(47%)	16 (57%)	12(43%)
Cotrimoxazole	18(47%)	20(53%)	19 (68%)	9(32%)
Vancomycin	38(100 %)	0	28(100 %)	0
Linezolid	38(100 %)	0	28(100 %)	0

DISCUSSION

Health care associated infections (HAIs) have become an important cause of mortality and morbidity and Staphylococcus aureus especially *Methicillin Resistant Staphylococcus aureus (MRSA)* is one of the frequent causes of HAIs. In our study frequency of MRSA was 16% while in a study by Salman MK et al [10] frequency of MRSA was found to be 9.3 %. Studies from various Asian countries have found an even lower prevalence of MRSA among HCWs. A study by Khanal R et al [11] reported prevalence of MRSA in HCWs of around 3.4% in Western Nepal while another study by Askarian M et al [12] reported 5.3% prevalence of MRSA among HCWs working in Iran. Malini et al [13] found 8% prevalence of MRSA in HCWs working in Banglore, India. These differences in prevalence of MRSA are due to the variability in geographical distribution, hospital settings, hospital specialties and areas within hospital where the study was conducted. It is important to emphasize the need for stringent hospital infection control policies regardless of whatever percentage prevalence of MRSA among health care workers exists. It is also important to stress the importance of hand hygiene among health care workers to prevent transmission of MRSA within the hospital and also to the attendants of the patient. Nurses showed statistically significant MRSA and MSSA carriage when compared with other working professions [Table 2] which is in accordance with the study conducted by C.A. Boncompain et al[1]. Similarly nurses had the highest MRSA carriage rate of 10% in an Indian study conducted in Bhubhaneshwar by Singh N et al [14]. In contrast, the carriage rate among nurses is very low (2.7%) in the study conducted at Kasturba medical college [15]. All the S. aureus isolates were 100% sensitive to vancomycin and linezolid (Table 3). Similarly study by Singh N et al also showed 100% sensitivity of MRSA to Vancomycin and Linezolid [14]. It is an encouraging finding that all the MRSA isolates are susceptible to vancomycin. So, this drug can be used for eradication of the MRSA carrier state as well as for treatment of patients infected with MRSA.

CONCLUSION

Based on the chance of person-to-person transmission, routine nasal screening and decolonization strategies should be considered by health care providing institutions. Currently, reevaluation of existing infection control practices, implementation of more effective practices (screening of MRSA carriers, isolation or cohorting of patients, colonised healthcare workers, and environmental decontamination, among others) should suffice.

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Ethical Approval: Approved

REFERENCES

1. Boncompain CA, Suárez CA, Morbidoni HR. Staphylococcus aureus nasal carriage in health care workers: First report from a major public hospital in Argentina. Rev Argent Microbiol 2017;49:125-131.

2. Rajaduraipandi K, Mani KR, Panneerselvam K, Mani M, Bhaskar M, Manikandan P, et al. Prevalence and antimicrobial susceptibility pattern of methicillin-resistant Staphylococcus aureus: A multicentre study. Indian J Med Microbiol 2006;24:34-8.
3. Albrich WC, Harbarth S. Health-care workers: Source, vector, or victim of MRSA? Lancet Infect Dis 2008;8:289-301.
4. Edem EN, Onwuezobe IA, Ochang EA, Etok CA, James IS. Antibiogram of bacterial isolates from the anterior nares and hands of health care workers in university of Uyo teaching hospital (UUTH) Uyo, AkwaIbom state, Nigeria. J Bacteriol Parasitol 2013;4:168.
5. Cirkovic I, Stepanovic S, Skov R, Trajkovic J, Grgurevic A, Larsen AR, et al. Carriage and genetic diversity of methicillin-resistant Staphylococcus aureus among patients and healthcare workers in a Serbian university hospital. PLoS One 2015;10:e0127347.
6. Emaneini M, Jabalameli F, Rahdar H, Leeuwen WBV, Beigverdi R. Nasal carriage rate of methicillin-resistant Staphylococcus aureus among Iranian healthcare workers: A systematic review and meta-analysis. Rev Soc Bras Med Trop 2017;50:590-7.
7. Kaur DC, Narayan PA. Mupirocin resistance in nasal carriage of Staphylococcus aureus among healthcare workers of a tertiary care rural hospital. Indian J Crit Care Med 2014;18:716-21.
8. W. C. Albrich and S. Harbarth, "Health-care workers: source, vector, or victim of MRSA?," 3e Lancet Infectious Diseases, vol. 8, no. 5, pp. 289–301, 2008.
9. R. P. Vonberg, S. Stamm-Balderjahn, S. Hansen et al., "How often do asymptomatic healthcare workers cause methicillinresistant Staphylococcus aureus outbreaks? A systematic evaluation," Infection Control & Hospital Epidemiology, vol. 27, no. 10, pp. 1123–1127, 2006.
10. Salman MK, Ashraf MS, Iftikhar S, Baig MAR. Frequency of nasal carriage of Staphylococcus Aureus among health care workers at a Tertiary Care Hospital. Pak J Med Sci. 2018; 34(5):1181-1184.
11. Khanal R, Sah P, Lamichhane P, Lamsal A, Upadhaya S, Pahwa VK, et al. Nasal carriage of methicillin resistant Staphylococcus aureus among health care workers at a tertiary care hospital in Western Nepal. Antimicrob Resist Infect Control. 2015;4(1):39.
12. Askarian M, Zeinalzadeh A, Japoni A, Alborzi A, Memish ZA. Prevalence of nasal carriage of methicillin-resistant Staphylococcus aureus and its antibiotic susceptibility pattern in healthcare workers at Namazi Hospital, Shiraz, Iran. Int J Infect Dis. 2009;13(5):241-247.
13. Malini J, Harle SA, Padmavathy M, Umapathy B, Navaneeth B, Keerthi Mannan J, et al. Methicillin-resistant Staphylococcus aureus Carriage among the Health Care Workers in a Tertiary Care Hospital. J Clin Diagnost Res. 2012;6(5):791- 793.
14. Singh N, Mohanty S, Panda SS, Sahoo S, Pattnaik D, Jena J. Methicillin resistant staphylococcus aureus (MRSA) carriage among health care workers in a tertiary care hospital in Bhubhaneshwar. Int J Community Med Public Health. 2018 Aug;5(8):3276-3282.
15. M Radhakrishna, Souza MD, Kotigadde S. Prevalence of Methicillin Resistant Staphylococcus aureus Carriage amongst Health Care Workers of Critical Care Units in Kasturba Medical College Hospital, Mangalore, India. J Clin Diagnos Res. 2013;2:697–700.

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